DOCUMENT RESUME

ED 132 051 SE 021 746

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TITLE Scientific Training in Brazil.
PUB DATE [76]
NOTE 11p.; Not available in hard copy due to marginal legibility of original document

EDRS PRICE MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS *Doctoral Programs; *Educational Programs; Graduate Students; Graduate Study; *Higher Education; *Science Education; Science History; *Sciences; *Scientists
IDENTIFIERS *Brazil

ABSTRACT

Described are the history and current trends of graduate level training of scientists in Brazil. Current and probable future problems are considered. (SL)

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SCIENTIFIC TRAINING IN BRAZIL

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Abstract: The training of scientists in Brazil is discussed in general, without going into details and into the differences of the various scientific areas. After a bird's-eye view of the history, the present situation is described and some of the problems are pointed out. A brief incursion into the future is ventured.

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In what follows, a brief discussion of the training of scientists in Brazil is presented. The approach is rather personal, and is certainly biased due to the fact that the author is a theoretical physicist.

As the training of scientists is very dependent on the support for research, there will necessarily be some overlap of this talk with the next one by Professor Sala.

As you have already heard and will hear again, the first milestone of the scientific development in Brazil was

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the creation, in 1934, of the Faculty of Philosophy, Sciences and Letters of the University of São Paulo (USP). Although before that several isolated scientific activities, including training of scientists, had taken place mainly in governmental institutes, the institutionalization of research activity started at the mentioned time, through the coming to São Paulo of several European scientists, especially in Mathematics, Physics, Chemistry and Biology. These scientists started to create a research atmosphere at USP, establishing small research groups and sending students to Europe and North America for scientific training, i.e., in this case to get their Ph.D.. In this way already in the fifties a graduate study programme existed at USP in which Ph.D. degrees (but not M.Sc. or M.A. ones) were awarded. In order to avoid misunderstandings, it must be said that these Ph.D. degrees had a level comparable to the one of US and European degrees, and were internationally recognized as such.

The second milestone, extremely relevant to the development of research and to the training of scientists in Brazil, was the creation, in 1951, of the National Research Council (CNPq), a federal organization with similar functions and aims as the ones of the American National Science Foundation. Through the award of grants and fellowships in Brazil and abroad (the fellowships in Brazil ranging from undergraduate students to senior researchers), CNPq gave the means and ways for the start or the further development of research groups all over Brazil. In particular, CNPq made it

possible for some institutions to also establish graduate study programmes, following more or less closely the example of USP which, as mentioned, was based on the European system (very few formal courses, the main activity being literature seminars or informal courses and research work).

As you have already heard much about other sciences, let me give you an example, dating from the fifties, in Physics. It was at this time that the Brazilian Centre for Research in Physics (CBPF) was created, and immediately flourished and became one of the leading Physics institutes in Brazil. The Department of Physics of USP and the CBPF were the two institutes which gave the basis for the development of research in Physics in Brazil, and the training of nearly all Brazilian physicists during that time was directly or indirectly influenced by these two institutions.

Following the creation of CNPq, there was created in the Ministry of Education and Culture, the Comission for the Training of University Professors (CAPES), which has as its main goal to allow University Professors to improve their scientific qualifications. CAPES provides grants for graduate courses and fellowships (in Brazil and abroad) for lecturers in the Universities to obtain a degree.

During this period there was also founded the National Comission for Nuclear Energy (CNEN, the equivalent of the former American AEC) which, through fellowships and research grants, played an important rôle in training scientists not only in the area of nuclear energy but also in related basic sciences.

Besides, several States (starting, of course, with the

State of São Paulo), created Foundations to support research and the training of scientists within the respective State, as you will hear in the next talk. Through the award of fellowships similar to the ones of CNPq, these Foundations had a strong influence on the training of scientists, in particular the Foundation of the State of São Paulo (FAPESP).

For the third milestone it is not possible to give a precise date. It happened during the last decade and started through the establishment by the Federal Government of rather strict rules for the graduate studies in Brazil. These rules, partly based on the American system (credit courses), introduced the master degree, besides the existing Ph.D., and determined that only those degrees are valid which are awarded by an institution recognized by the Federal Council of Education (CFE), a body which consists of University Professors, Educators and other specialists interested in education and/or research. This body is rather strict and careful in recognizing "graduate institutions", especially as far as institutions with "Ph.D. rights" are concerned.

As you will hear in the next talk, during this time the National Fund for the Development of Science and Technology (FNDCT) was created. As a consequence, the National Bank of Economical Development (BNDE) started to award relatively large grants to graduate courses, indicated to BNDE by CNPq. This, again, had a strong influence on the performance of the graduate courses. It allowed the purchase of relatively large amounts of equipment and supplies and, more important than this, to supplement salaries of scientists (especially foreign) visitors), thus increasing substantially the capacity and

performance of the good graduate courses and giving the means to create new ones.

Due to the rapid development of Brazil and to the requirements and desires of the Universities, we have seen in Brazil during this decade a proliferation of graduate courses, mainly awarding master degrees, not recognized by CFE and very often not having the level internationally required for such activity. Therefore, and also in order to set priorities and to quantify the needs of the Universities and research institutes in trained scientists, a high level comission has been established by the Government. This National Comission of Graduate Studies (CNPG), in the federal ministerial level, has now established a National Plan for Graduate Studies (PNPG), which sets the general graduate policy for the whole country.

Having given this historical sketch, let me now tell you in a nut shell how I see the situation presently. There are some very good research institutes, mainly at Universities, which give a scientific training according to international standards, awarding Ph.D. degrees and giving post doctoral training (although most of them prefer their recent Ph.D.s to get their post doctoral abroad) and there are many other institutions which award master degrees, some of them of rather low quality. Although one can hardly say that these institutions give scientific training, they have to be mentioned in this context in order to understand what follows.

Due to the needs of University trained people to participate in the development of Brazil, the existing Universities have to accept more and more undergraduate

students and new Universities or Schools (Engineering, Medicine, etc.) have to be created. Consequently, there is a large demand for university professors, and necessarily the academic level and training of these professors has to be done fast, and thus the level of both the professors and of the students decreases. For example, there are some Universities which are very happy to get into their academic staff a person with a master degree awarded by one of the low level courses mentioned above. Of course, this is not true for the traditional large Universities. But, on the other hand, to give you a characteristic example applicable to most traditional Universities, up to recently a person having a master degree would, in a Federal University, get the salary of an assistant professor, and one with a Ph.D. of an associate professor. Obviously, the described situation constitutes a strong handicap for the training of scientists. Another serious drawback is that the major part of the University professors in most Universities would, up to recently, prefer to work in part time, only lecturing and not doing research. This situation is now slowly being corrected, through very decisive measures of the government. I think that the problems discussed above are essential to understand the general University situation in Brazil, as far as scientific training is concerned.

In the remaining part of this talk I will now restrict myself to the problems existing in the training of scientists proper, as it is understood internationally.

As you may have concluded by now, the training of Brazilian scientists, which originally was done mainly abroad, is now to a major part done in Brazil. I would say that the graduate system is a mixture between the American and the European one. In general, up to the master degree the credit system is rather rigid, but a Thesis (called Dissertation) is needed to obtain the M.Sc. or the M.A.. The master degree is in general a pre-requisite for the Ph.D.. To obtain the doctor degree, the system is more flexible, the main requirement being the research activity, with little emphasis on formal course work. This is possible because there are not too many candidates for a Ph.D. degree in most of the Institutions*, thus allowing also the establishment of an individual study programme for each student (besides the obviously individual research programme).

After having got the Ph.D., the general rule is that post doctoral research is done abroad, with fellowships from CNPq, CAPES or a State Foundation (especially FAPESP). This stay abroad, mainly in the U.S. or Europe, is in general of about two years.

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* The statement that we have relatively few graduate students brings me to a side remark of a sociological nature: Engineering, Medicine and Law are still the Schools with highest demand in Brazilian universities. An Engineer or a Doctor or a Lawyer (without any graduate degree) has more social prestige (besides making more money) than a scientist.

Those areas in which it is impossible to obtain a Ph.D. in Brazil, there are of course fellowships available to get the degree abroad. In this case it is very often convenient to have the course work done in Brazil and the research for the Thesis abroad.

And this brings me to the last part of this talk, in which I would like to deal with some problems relevant to scientific training which we are facing now and will face in the future.

To do the course work in Brazil and the research work abroad in order to obtain a Ph.D. degree is a very convenient and economical way of training Brazilian scientists. However, it is formally not very easy: If the degree is given by the institution abroad, e.g. by a University in the U.S., the course work and examinations done in Brazil have to be accepted by the respective University in the U.S., which is a major problem. On the other hand, if the degree is to be given by the Brazilian University, it will be difficult to persuade the Professor and the University abroad to take care of the supervision of the Thesis. May be we could touch this point in the Pannel Discussion later on.

Another problem, which I consider very serious, are the areas in which research and consequently scientific training is done in Brazil. Basic sciences are predominant to a large degree! I would even venture to state that hardly any applied or technological research is done at all. Of course, there exists technological transfer (sometimes called "research")

but it is absolutely necessary to train scientists in applied and technological research. I could, in the Pannel Discussion later on, take up this point again if desired.

Another problem we are facing is the lack of qualified scientists in Brazil, to take care of the training of students and of post docs. Therefore, we have to "import" foreign scientists to staff our graduate courses. Although it would seem that it should not be difficult in the present situation to hire qualified scientists abroad, the fact is that the opposite is true. It is not difficult to obtain recent Ph.D.s., but experienced scientists, which are the ones we really need, have strong reasons not to leave their country presently. Unlike the two preceding problems, on which I have some ideas for the solution, I do not see any way of solving this particular problem.

Another point which I would like to mention and which brings out a clear distinction between Brazil and the U.S. or Europe is the mobility of scientists. It is very common (actually, it is the rule) that somebody does his undergraduate studies at one University, his graduate ones at the same University, gets a job at this University and ends up as a full professor at this very same University. Of course, in between this scientist has been abroad for one, two, three or may be even more years, and possibly has been a visitor at another Brazilian University; but his basis is always the University where he has studied. It is, e.g., extremely seldom that a full Professor of one

University becomes a full Professor at another one. I don't think that I need to discuss the disadvantages of this non--existence of "cross-fertilization".

Although there are of course many other problems in the training of scientists in Brazil, there is a last one which I think is a major bottleneck. One of the tasks of the scientists is to advise the government on scientific questions. As there are much too few qualified scientists in Brazil, it is extremely difficult to find some which are willing to stop to do research and go into policy making government administration. And if more scientists would do so, the training of new scientists would strongly suffer from it.

These are a few of the many problems we are facing presently in the scientific training in Brazil and which have to be solved in the very near future. As far as I can judge, based on the Brazilian general policy on Science and Technology, there is a deep concern within the government on these subjects. The very existence of the Basic Plan of Scientific and Technological Development (PBDCT), the recent transformation of CNPq in the National Council for Scientific and Technological Development, the change in policy of the Financing Agency for Studies and Projects (FINEP) and some other facts, show this very clearly.

Therefore, I would like to conclude by stating that I am personally very optimistic about the future development of Science in Brazil, in particular with respect to the training of young scientists, provided we find solutions for the mentioned problems.